

► flashes of light that the muon produced in its wake. The particle seemed to emerge from below the detector — an orientation that indicated it was the decay product of a neutrino that had come from below the horizon. Muons can travel only so far inside matter, whereas neutrinos often pass through the entire planet unimpeded; most of the muons that IceCube detects originate from neutrinos that have crashed with a particle inside Earth.

Within seconds, a computer cluster at the US National Science Foundation's Amundsen–Scott South Pole Station had reconstructed the precise path of the particle and recognized that the muon had come from a highly energetic neutrino; 43 seconds after the event, the station sent an automated alert to a network of astronomers through a satellite link. It tagged the neutrino as IceCube-170922A.

After receiving the alert, Derek Fox, an astrophysicist at Pennsylvania State University in University Park, quickly secured observing time on the X-ray observatory Swift, which orbits Earth. He and his team found nine sources of high-energy X-rays close to where the neutrino had come from. Among them was an object called TXS 0506+056. This is a blazar, a galaxy with a supermassive black hole at the centre and a known source of γ -rays. In a blazar, the black hole stirs up gas to temperatures of millions of degrees and shoots it out of its poles in two highly collimated jets. In

this case, one of the jets points in the direction of the Solar System. Fox's team announced its findings to the astronomical community the next day.

In the following days, another team inspected data from Fermi-LAT, the Large Area Telescope aboard NASA's Fermi Gamma-ray Space Telescope. Fermi-LAT constantly sweeps the sky, and among other things monitors about 2,000 blazars. These objects go through periods of increased activity that can last weeks or months, during which they become unusually bright. “When we looked at the region that IceCube said the neutrino came from, we noticed that this blazar had been flaring more than ever before,” says Regina Caputo, an astrophysicist at NASA's Goddard Space Flight Center in Greenbelt, Maryland, who is Fermi-LAT's analysis coordinator.

On 28 September, the Fermi-LAT team sent out an alert to reveal this finding. It was at that point that other astronomers got excited. IceCube has detected about a dozen such high-energy neutrinos each year since it started operating in 2010, but none had been associated with a particular source in the sky. “That's

what made the hair stand at the back of the neck,” Fox says.

Researchers with IceCube and Fermi-LAT calculated the odds that the flare and the neutrino were related, rather than coming from the same direction in the sky by chance. They found that likelihood to be good, although not at the level of statistical significance required for claiming a discovery in physics^{1,2}.

A major missing piece of information was the blazar's distance from Earth, says Simona Paiano of the Astronomical Observatory of Padua in Italy. To measure it, she and her team booked 15 hours of observing time on the world's largest optical telescope, the 10.4-metre Gran Telescopio Canarias on La Palma, one of Spain's Canary Islands. They found the blazar to be around 1.15 billion parsecs (3.78 billion light years) away³.

Together, the data pinpoint the likely source, says Kyle Cranmer, a particle physics and data-analysis expert at New York University, but “the observation isn't unambiguous”, he cautions. “More follow-up is needed to conclusively establish blazars as a source of high-energy neutrinos.” ■

1. IceCube Collaboration. *Science* **361**, 147–151 (2018).
2. IceCube Collaboration *et al.* *Science* **361**, eaat1378 (2018).
3. Paiano, S., Falomo, R., Treves, A. & Scarpa, R. *Astrophys. J. Lett.* **854**, L32 (2018).

EPIDEMIOLOGY

Chinese cities scan sewers for signs of illegal drug use

Privacy concerns and cultural differences could limit the technique's use in other nations.

BY DAVID CYRANOSKI

Dozens of cities across China are applying an unusual forensic technique to monitor illegal drug use: chemically analysing sewage for traces of drugs, or their telltale metabolites, excreted in urine.

One southern city, Zhongshan, a drug hot-spot, is also monitoring waste water to evaluate the effectiveness of its drug-reduction programmes, says Li Xiqing, an environmental chemist at Peking University in Beijing who is working with police in these cities.

Li says Zhongshan police have already used the technique to help track down and arrest a drug manufacturer. He says a handful of cities are planning to use data from waste water to set targets for police arrests of drug users, some as early as next year.

Although illegal drug use has been monitored through wastewater-based epidemiology (WBE) in other countries, including Belgium, the Netherlands, Spain and Germany, most studies have collected data for epidemiological research rather than for setting policies. “The noteworthy part is that China seems to be actually acting on the technique,” says Daniel Burgard, a chemist at the University of Puget Sound in Tacoma, Washington.

Last month, Chinese President Xi Jinping said that the country's war on drugs was tied to national security and the welfare of the Chinese people. Li says the central and local governments will invest at least 10 million yuan (US\$1.5 million) in WBE monitoring by the end of the year. He expects the figure to at least double annually for the next few years.

Li is pushing for the method to be used

internationally, including as part of the United Nations' drug control policies. “The experience and lessons from the application of WBE and its adoption by the Chinese drug police in their daily management will be very relevant for other countries,” he argues.

But many issues, such as how police should be allowed to analyse the data, the need for safeguards to prevent the data from being misused, and privacy concerns, need to be ironed out. Some researchers are sceptical that the method will be adopted successfully in other countries.

DRUG USE

To show that WBE reflects drug use in the community, a number of studies have compared drug levels detected in sewage with other data sources on drug use, such as the amount



Chinese officers destroy seized drugs.

because they are indirect measures. “WBE offers an unequivocal measure of the effectiveness of efforts,” says Zhang.

Li and his team put this to the test when they measured two popular synthetic drugs, methamphetamine and ketamine, in waste water across China two years after local and national agencies launched campaigns to crack down on drug use and manufacturing in 2013. Zhang’s team found that after these initiatives, methamphetamine use dropped by 42% and ketamine use decreased by 67%. Li thinks the drop in drug use is a result of police campaigns.

OTHER COUNTRIES

Jose Antonio Baz-Lomba, a researcher at the Norwegian Institute for Water Research in Oslo, says the growing evidence that the technology is a reliable measure of drug use should encourage other international police authorities to take WBE seriously and start collaborating with researchers.

But Carsten Prasse, an environmental-health researcher at Johns Hopkins University in Baltimore, Maryland, argues that cultural and political differences between countries will have a substantial effect on this research. “In China, the general population is used to following the directions given by the government, and privacy-related issues don’t seem to be a major concern — the situation is totally different in the United States,” he says.

Prasse says the potential implementation of wastewater-based drug monitoring needs to be discussed in the community, not only between scientists and law enforcement. “WBE represents a powerful new tool to assess drug consumption in our cities, but there is still a lot of work to do before it can be implemented on a larger scale,” he says. ■

of drugs seized by police, and user surveys. A 2016 study in eight European cities found a strong correlation between the amount of cocaine detected in waste water and data from drug seizures (J. A. Baz-Lomba *et al.* *BMC Public Health* 16, 1035; 2016). However, in the case of metamphetamines, the correlation was not as strong.

Researchers around the world generally agree that WBE can reliably estimate drug use, says Shane Neilson, the head of Determination for High Risk and Emerging Drugs at the Australian Criminal Intelligence Commission in Canberra. “The science and findings are

globally consistent and comparable,” he says. The technique is also used by health researchers to detect other substances excreted by humans, such as signs of bacteria and viruses.

Zhang Lei, an environmental policy researcher at Renmin University in Beijing who collaborates with Li, notes that WBE studies are a more objective way of measuring whether government initiatives to reduce drug use in the community are working. She says that relying solely on conventional methods for monitoring changes in drug use, such as the number of arrests of users or the number of drugs being seized by police, can be misleading

PUBLISHING

Experimental open-access deal ends

Science’s pilot contract with the Gates Foundation aimed to solve a policy conundrum that affects several journals.

BY RICHARD VAN NOORDEN

The publisher of *Science* last month ended a pilot partnership that allowed open-access (OA) publishing for researchers funded by the Bill & Melinda Gates Foundation.

The trial was an effort to accommodate a policy clash between the Gates Foundation, which has enforced strict OA demands since

2017, and publishers running subscription journals that don’t comply with those terms. So far, 26 papers have been published in *Science* and 4 sister subscription journals as part of the 18-month experiment, and more might appear, says a spokesperson for *Science*’s publisher, the American Association for the Advancement of Science (AAAS) in Washington DC. Neither the Gates Foundation nor the AAAS commented on why the deal ended.

Under the contract, the Gates Foundation paid the AAAS a lump sum of around US\$100,000 for a trial first year, during which 16 papers appeared. The two organizations then extended their partnership for another six months, and continued their contract on “similar terms,” but have agreed to keep the extra amount paid confidential, says Bryan Callahan, an external-relations officer at the Gates Foundation.

Meanwhile, two other influential journals, *The New England Journal of Medicine* (NEJM) and *Proceedings of the National Academy of Sciences* (PNAS), quietly changed their policies last year to offer a permanent OA publishing route for Gates grant holders. And although *Nature* has not made a specific agreement with funders, it has published some papers under OA terms, including two Gates-funded papers this year. (*Nature*’s news team is editorially independent of its journal team and of its publisher, Springer Nature.)

The Gates Foundation, based in Seattle, ►